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GEOLOGY, ENERGY, AND MINERAL (GEM) RESOURCE ASSESSMENT OF THE MUDDY RIDGE GEM RESOURCE AREA (GRA), WYOMING, INCLUDING THE EAST FORK WILDERNESS STUDY AREA (WY-040-106); AND MILL CREEK WILDERNESS STUDY AREA (WY-040-335)

PHASE I

Contract No. YA-553-CT2-1055

Prepared for:

U.S. Bureau of Land Management

Prepared by:

Tetra Tech, Inc.
Pasadena, California

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August 1983

GEOLOGY, ENERGY, AND MINERAL (GEM) RESOURCE ASSESSMENT OF THE MUDDY RIDGE GEM RESOURCE AREA (GRA), WYOMING, INCLUDING THE EAST FORK WILDERNESS STUDY AREA (WY-040-106); AND MILL CREEK WILDERNESS STUDY AREA (WY-040-335)

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EXECUTIVE SUMMARY

The U.S. Bureau of Land Management (BLM) has adopted a two-phase procedure for the integration of geologic, energy, and mineral (GEM) resources data for suitable/nonsuitable decisions concerning Wilderness Study Areas (WSAs). To facilitate this review, certain WSAs with similar geologic environments and mineral characteristics have been grouped together into larger GEM Resource Areas (GRA). Using these guidelines, the East Fork and Mill Creek WSAs were grouped together into the larger Muddy Ridge GRA. This report, which terminates the Phase I activities for the Muddy Ridge GRA, is an evaluation and interpretation of existing data concerning the GEM resource potential in the East Fork and Mill Creek WSAs.

The Muddy Ridge GRA contains two WSAs: the East Fork WSA (WY-040-106), and the Mill Creek WSA (WY-040-335). The East Fork WSA is located in the BLM's Pinedale Resource Area, Rock Springs District, Wyoming. The Mill Creek WSA is located in the BLM's Big Sandy Resource Area, Rock Springs District, Wyoming.

Both the East Fork and Mill Creek WSAs are considered to have a low favorability based on indirect evidence for the potential occurrence of sand and gravel (classified 2B). This classification is based upon the occurrence of favorable geologic environments indicated by the geologic mapping (Love et al., 1979), and a brief review of aerial photography of the area. The geologic environment and inferred geologic processes that have been identified in the study area are not favorable for the potential occurrence of other GEM resources. Also, the available information is insufficient to support or refute the existence of other GEM resources. Therefore, both the East Fork and Mill Creek WSAs are considered to be unfavorable for the potential occurrence of other GEM resources (classified 1A).

Additional geologic investigations would be needed to supplement the GEM resource evaluation of the Muddy Ridge GRA. A brief, aerial photographic interpretative study would help differentiate surficial deposits from bedrock. Also, a field reconnaissance would help evaluate the area's potential for other GEM resources in the Precambrian rocks.

TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY.. i

1.0 INTRODUCTION.. 1

1.1 Purpose of Study.. 1
1.2 Location and Access... 1
1.3 Basis for Report.. 3

2.0 GEOLOGY... 5

2.1 General... 5
2.2 Physiography.. 5
2.3 Geologic Units.. 6
2.3.1 Bedrock Units... 6
2.3.2 Surficial Deposits.. 6
2.4 Structural Geology.. 9
2.5 Engineering Geology... 9
2.6 Paleontologic Resources....................................... 9
2.7 Historical Geology.. 9

3.0 ENERGY AND MINERAL RESOURCES.................................. 10

3.1 General... 10
3.2 Potential Resources... 12
3.3 Land Status... 12
3.4 Deposit Types... 12
3.5 Resource Economics.. 12
3.5.1 Sand and Gravel... 12
3.5.2 Strategic and Critical Minerals............................. 14

4.0 LAND CLASSIFICATION FOR GEM RESOURCE POTENTIAL........................ 14

4.1 General.. 14
4.2 Sand and Gravel.. 14
4.3 Other GEM Resources.. 17

5.0 RECOMMENDATIONS FOR FURTHER WORK.. 17

5.1 Work Recommended to Complete Data Base......................... 17

6.0 REFERENCES AND SELECTED BIBLIOGRAPHY.................................... 17

FIGURES

1.1 GRA Location Map.. 2
1.2 Topographic Map... 4
2.1 Geologic Map.. 7
2.2 Generalized Stratigraphic Column.. 8
3.1 Mineral Occurrence Map.. 11
3.2 Claim and Lease Map... 13
4.1 Land Classification Map... 15
4.2 Resource Classification Scheme.. 16

GEM RESOURCE AREA

MUDDY RIDGE

1.0 INTRODUCTION

1.1 Purpose of Study

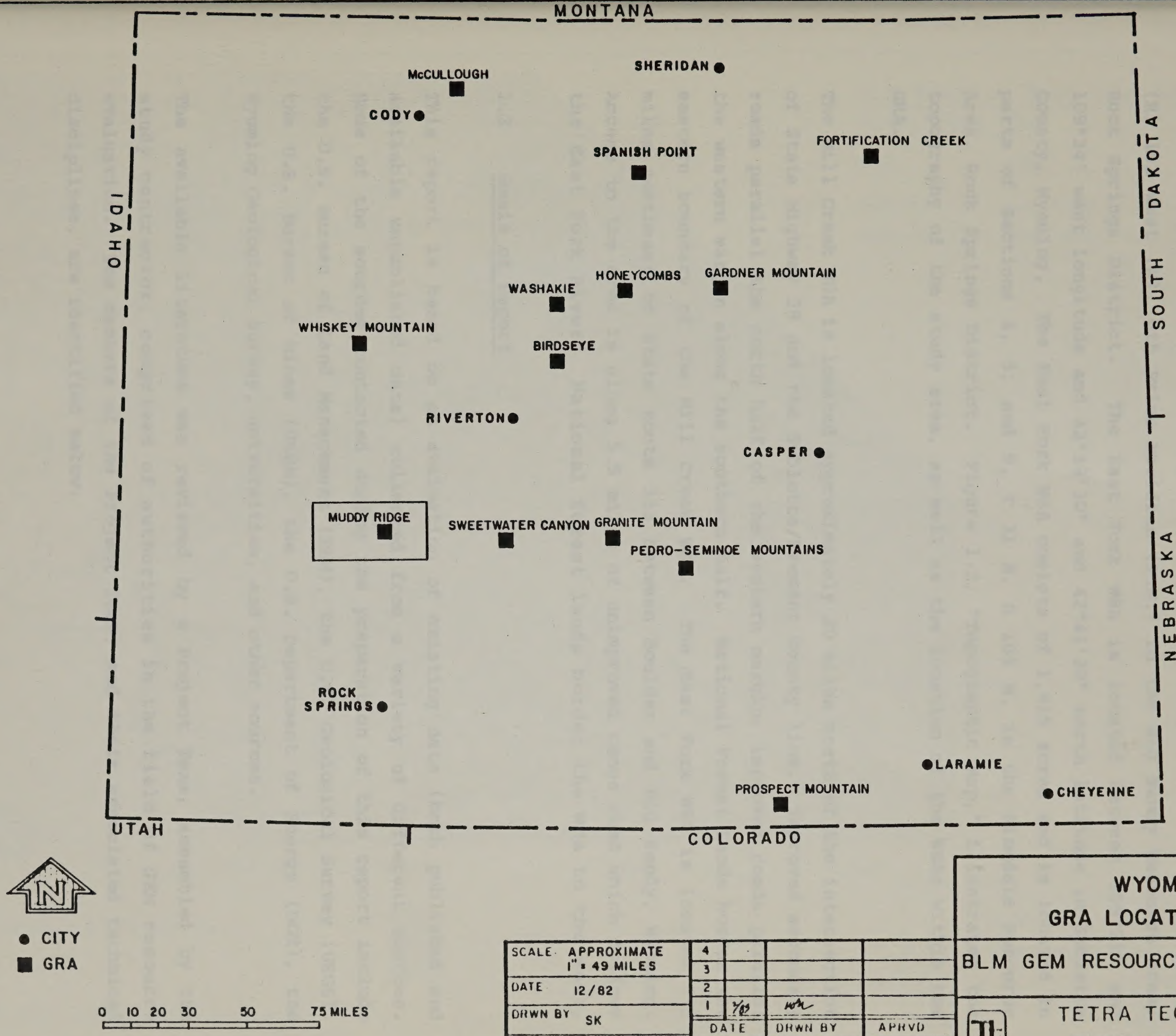
The U.S. Bureau of Land Management (BLM) has adopted a two-phase procedure for the integration of geologic, energy, and mineral (GEM) resources data for suitable/nonsuitable decisions concerning Wilderness Study Areas (WSAs). Phase I consists of a review and evaluation of existing data, resulting in an interpretation of the GEM resource potential of the WSAs. Phase II is designed to generate only the additional data required to support the GEM resource recommendations presented during Phase I. To facilitate this review, certain WSAs with similar geologic and mineral characteristics have been grouped together into larger GEM Resource Areas (GRAs). Using these guidelines, the Mill Creek and East Fork WSAs were grouped into the large Muddy Ridge GRA. This report, which terminates the Phase I activities for the Muddy Ridge GRA, is an evaluation and interpretation of existing data concerning the GEM resource potential in the WSAs.

The GEM resource evaluations for this study were performed by Tetra Tech, Inc. for the U.S. Bureau of Land Management, under Solicitation No. YA-553-CT2-1055. This study was completed in August, 1983.

1.2 Location and Access

This GEM report covers the area identified as the Muddy Ridge GEM Resource Area (GRA); the geographic location of the study area is shown in Figure 1.1, "GRA Location Map."

The Muddy Ridge GRA contains two WSAs: the Mill Creek WSA (WY-040-335), and the East Fork WSA (WY-040-106). The Mill Creek WSA is located between 109°2'30" and 109°5' west longitude, and 42°31' and 42°34' north latitude, in



WYOMING
GRA LOCATION MAP

BLM GEM RESOURCES ASSESSMENT

TETRA TECH INC.
PASADENA, CALIFORNIA

FIGURE 1.1

SCALE APPROXIMATE 1" = 49 MILES
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Fremont County, Wyoming. The Mill Creek WSA consists of 1,300 acres and is located in parts of Sections 19, 30, and 31, Township (T) 30 North (N), Range (R) 102 West (W), 6th Prime Meridian (P.M.) in the Big Sandy Resource Area, Rock Springs District. The East Fork WSA is located between 109°21' and 109°24' west longitude and 42°39'30" and 42°41'30" north latitude in Sublette County, Wyoming. The East Fork WSA cosists of 1,415 acres and is located in parts of Sections 4, 5, and 9, T 31 N, R 105 W, in the Pinedale Resource Area, Rock Springs District. Figure 1.2, "Topographic Map," illustrates the topography of the study area, as well as the location of the WSAs within the GRA.

The Mill Creek WSA is located approximately 20 miles north of the intersection of State Highway 28 and the Sublette/Fremont County line. Improved secondary roads parallel the north half of the western margin; improved roads parallel the western margin along the southern half. National Forest Lands border the eastern boundary of the Mill Creek WSA. The East Fork WSA is located 5.5 miles northeast of State Route 353 between Boulder and Big Sandy, Wyoming. Access to the area is along 5.5 miles of unimproved range road which follows the East Fork River. National forest lands border the WSA to the east.

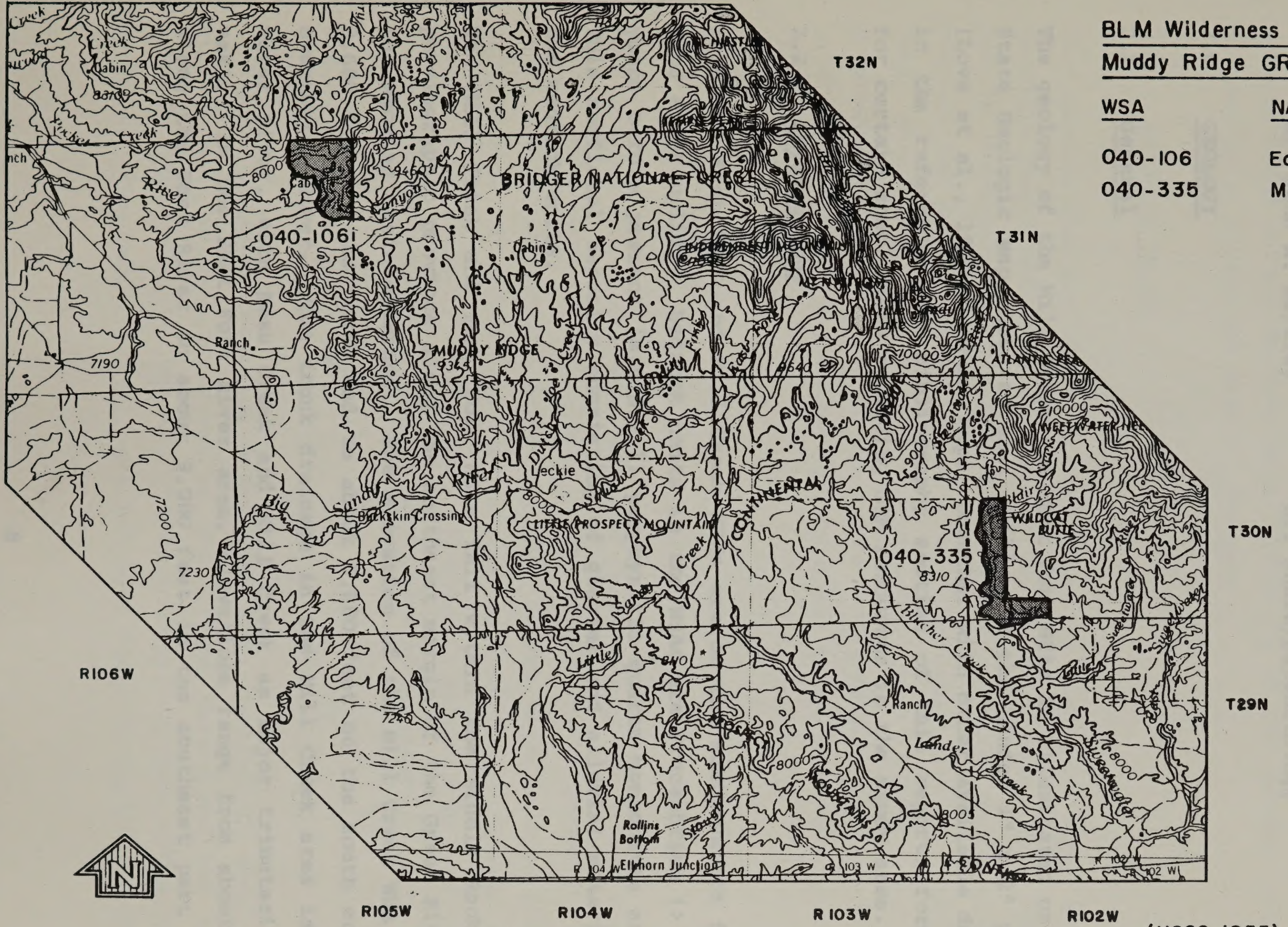
1.3 Basis of Report

This report is based on an evaluation of existing data (both published and available unpublished data) collected from a variety of different sources. Some of the sources contacted during the preparation of this report include the U.S. Bureau of Land Management (BLM), the U.S. Geological Survey (USGS), the U.S. Bureau of Mines (USBM), the U.S. Department of Energy (DOE), the Wyoming Geological Survey, universities, and other sources.

The available literature was reviewed by a Project Team, assembled by the study contractor, comprised of authorities in the field of GEM resource evaluation. The members of the Project Team, and their associated technical disciplines, are identified below:

BLM Wilderness Study Areas Included in the Muddy Ridge GRA

WSA	NAME	ACREAGE
040-106	East Fork	1,415
040-335	Mill Creek	1,300



(USGS,1955)

NOTE: Contours in 200ft. intervals.

▨ Approximate Boundary of Wilderness Study Area

SCALE: 1" = 4 MILES 1:250,000	4				Muddy Ridge GRA, Wyoming TOPOGRAPHIC MAP
	3				BLM GEM RESOURCES ASSESSMENT REGION 6 WYOMING and MONTANA
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		DATE	DRWN BY	APRVD	FIGURE 1.2
APRVD: WL	REVISIONS				

Mr. Charles S. Robinson	Metallic Minerals/Non-Metallic Minerals
Mr. Rollin E. Phipps	Oil and Gas
Mr. Andrew G. Alpha	Geothermal Resources
Mr. Stuart P. Hughes	Other Minerals
Mr. William A. Gallant	Other Minerals
Mr. Elmer M. Schell	Coal
Mr. John A. Hartley	Oil Shale/Paleontology

2.0 GEOLOGY

2.1 General

The geology of the Mill Creek and East Fork WSAs is illustrated on the Wyoming State Geologic Map (Love et al., 1955), and the Lander 1° x 2° geologic map (Love et al., 1979). These maps, together with other available data included in the references and bibliography section of this report, form the basis for certain conclusions regarding GEM resources in the study area.

2.2 Physiography

Both the East Fork and Mill Creek WSAs are on the southwestern flank of the Wind River uplift. Bedrock units in the WSAs are Precambrian (> 600 million years before present [m.y.B.P.]) porphyritic quartz monzonites and granites. Thin surficial deposits consisting of glacial and alluvial materials overlie the bedrock units.

The Mill Creek and East Fork WSAs fall within the Middle Rocky Mountains physiographic province along the northeast margin of the Green River Basin at the Wyoming Basin province. The elevation of the Mill Creek WSA ranges from 8,600 feet on the north end to about 7,880 feet on the south end along the Sweetwater River. The trunk drainage in the Mill Creek area is the Sweetwater River, with Beau Creek and Mill Creek as major tributaries from the east. In the East Fork River area, elevations range from about 7,800 feet along the East River to about 9,000 feet in the southeast part of the WSA.

In the East Fork WSA, the primary trunk stream is the East Fork River. Irish Canyon Creek forms part of the southern and western boundary of the East Fork WSA, while Jim Creek forms part of the western boundary. The WSAs are characterized by rolling, occasionally steep and rugged topography, which is heavily to moderately timbered. The climate of the study area is similar to other high areas along the margin of the Green River Basin in that most precipitation occurs as deep snow during the winter months, with occasional thunderstorms during the rest of the year.

2.3 Geologic Units

The bedrock geologic unit that underlies the East Fork River WSA is a porphyritic quartz monzonite metaigneous rock of Precambrian age. The Mill Creek WSA is underlain by Precambrian granite. Alluvial and glacial deposits overlie the bedrock units. Figure 2.1, "Geologic Map," delineates the geologic formations that occur throughout the GRA. Figure 2.2, "Generalized Stratigraphic Column," is a generalized stratigraphic column which gives a brief description of all the stratigraphic units that crop out or underlie the Muddy Ridge GRA.

2.3.1 Bedrock Units

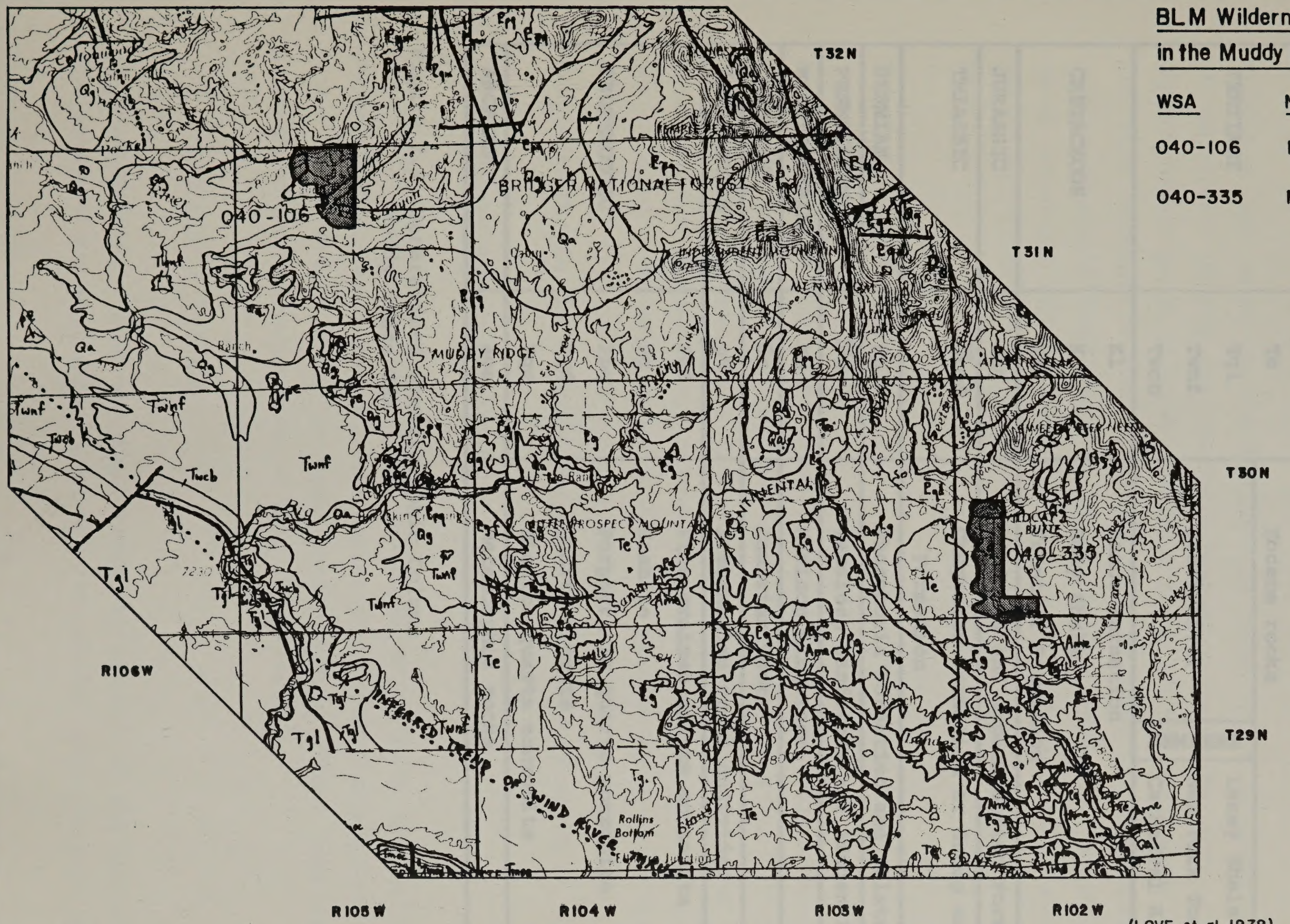
Both porphyritic quartz monzonite and granite crop out within the boundaries of the WSAs (Love et al., 1979). Porphyritic quartz monzonite is a quartz rich rock consisting of large crystals formed with an approximately equal distribution of potash and plagioclase feldspar in a fine-grained matrix. Granite is a coarsely crystalline, silica-rich metamorphic rock consisting of quartz, potash, feldspar, biotite, and minor accessories.

2.3.2 Surficial Deposits

Surficial deposits occurring within the WSAs consist of clay, silt, sand gravel, and boulders deposited by the streams that drain the WSAs. These deposits are generally less than 50 feet thick. Glacial deposits consisting of clay, silt, sand, gravel, and boulders occur primarily in the East Fork

BLM Wilderness Study Areas Included in the Muddy Ridge GRA

WSA	NAME	ACREAGE
040-106	East Fork	1,415
040-335	Mill Creek	1,300



(LOVE et al. 1979)

▨ **Approximate Boundary of Wilderness Study Area**

5 4 3 2 1 0 3 6 Miles

5 4 3 2 1 0 5 10 Kilometers

Muddy Ridge GRA, Wyoming

GEOLOGIC MAP

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FIGURE 2.1

SCALE 1" = 4 MILES
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SYSTEM	SYMBOL	FORMATION		
QUATERNARY	Qal	Alluvial deposits		
	Qc	Colluvial deposits		
	Qs	Windblown sand		
	Qg	Glacial deposits		
TERTIARY	Tmoc	Miocene and Oligocene Conglomerate		
	Te	Eocene rocks		
	Tgl	Green River	MEMBERS	Laney Shale
	Twnf			New Fork Tongue
	Twcb			Cathedral Bluffstongue
CRETACEOUS	Kl	Lance Formation		
	Kc	Cody Shale		
	Kf	Frontier Formation		
JURASSIC	Jsg	Sundance and Gypsum Spring Formations		
TRIASSIC	T̄R cd	Chugwater Formation or Group and Dinwoody Formation		
PERMIAN	Pp	Phosphoria Formation and related rocks		
PENNSYLVANIAN	ℙM	Tensleep Sandstone and Amsden Formation		
MISSISSIPPIAN	Mm	Madison Limestone		
CAMBRIAN	Єr	Cambrian Rocks		
PRECAMBRIAN	pЄ	Precambrian rocks undivided		
PROTEROZOIC	Pgf	Fine-grained quartz monzonite		
	Pg	Granite		
	Ppq	Porphyritic quartz monzonite		
	Pqd	Quartz diorite		
	Pqm	Biotite quartz monzonite		
ARCHEAN	Ame	Metamorphic rocks		

Figure 2.2 Generalized Stratigraphic Column
Muddy Ridge GRA

drainage along the valley walls. Surficial deposits have not been mapped but are expected to occur based upon a brief review of the aerial photography of the WSAs.

2.4 Structural Geology

Fractures and veins in the Precambrian rocks which occurred during periods of uplift and cooling may provide a host for mineral deposits. The Wind River thrust, which parallels the southwest flank of the Wind River Mountain Range and dips steeply to the northeast, has produced an environment for small uranium deposits that occur in the Tertiary rocks; the thrust has also produced potential oil and gas plays in older Paleozoic (225 m.y.B.P.) rocks. These conditions exist in parts of the GRA, but not within either of the WSAs.

2.5 Engineering Geology

A review of the engineering geology of the area reveals several significant features. Rockfalls can be expected in those portions of the WSAs with steep cliffs. Organic soils and peat will occur in the alluvium of the East Fork River because of the low gradient nature of the streams and the presence of beaver dams. Flooding can be expected in the study area along the major streams and tributaries during spring runoff, and after high intensity thunderstorms in the drainage areas during the summer months.

2.6 Paleontologic Resources

Vertebrate fossil localities are not expected to occur in the bedrock units. However, Pleistocene age animal remains are found within glacial deposits in other areas with similar geologic environments. These remains are usually exposed during the extraction of sand and gravel.

2.7 Historical Geology

The geologic history of the Muddy Ridge GRA is part of the geologic history of the middle Rocky Mountains. Basement Precambrian rocks consist of metaigneous

and metasedimentary rocks, the history of which is not well understood. At the end of the Precambrian time and throughout the Paleozoic era, there were repeated advances and retreats of the sea. During the deposition of the Paleozoic sediment, stratigraphic traps for hydrocarbons may have developed along facies changes, unconformities, and lithologic boundaries. Marine deposits of sandstone, shale, and limestone were formed. At the end of the Paleozoic era, marine, marginal marine (evaporites), and terrestrial red-bed deposits were formed as the seas fluctuated back and forth over the area. Marine conditions returned in Jurassic (135-180 m.y.B.P.) time, only to retreat at the end of the Jurassic period. A major marine invasion started in early Cretaceous (70-135 m.y.B.P.) time and continued until the start of the Laramide orogeny near the end of the Cretaceous period. The Laramide orogency caused uplift and erosion of all of the rocks that were deposited during previous geologic time so that only the oldest rocks of Precambrian age were left in the study area. At this time, there was also deposition of thick terrestrial sediments including coal in some of the intermountain basins. Volcanism was active in mid to late Tertiary (2-70 m.y.B.P.) time. During this period, thick volcanic deposits accumulated locally, and volcanic ash was widely distributed. The Quaternary (2-3 m.y.B.P.) period is noted for the widespread glaciation in the Wind River Mountains, and the accompanying glacial outwash deposits along the mountain flanks. The glacial and alluvial deposits that underlie parts of the WSAs were deposited during this period.

3.0 ENERGY AND MINERAL RESOURCES

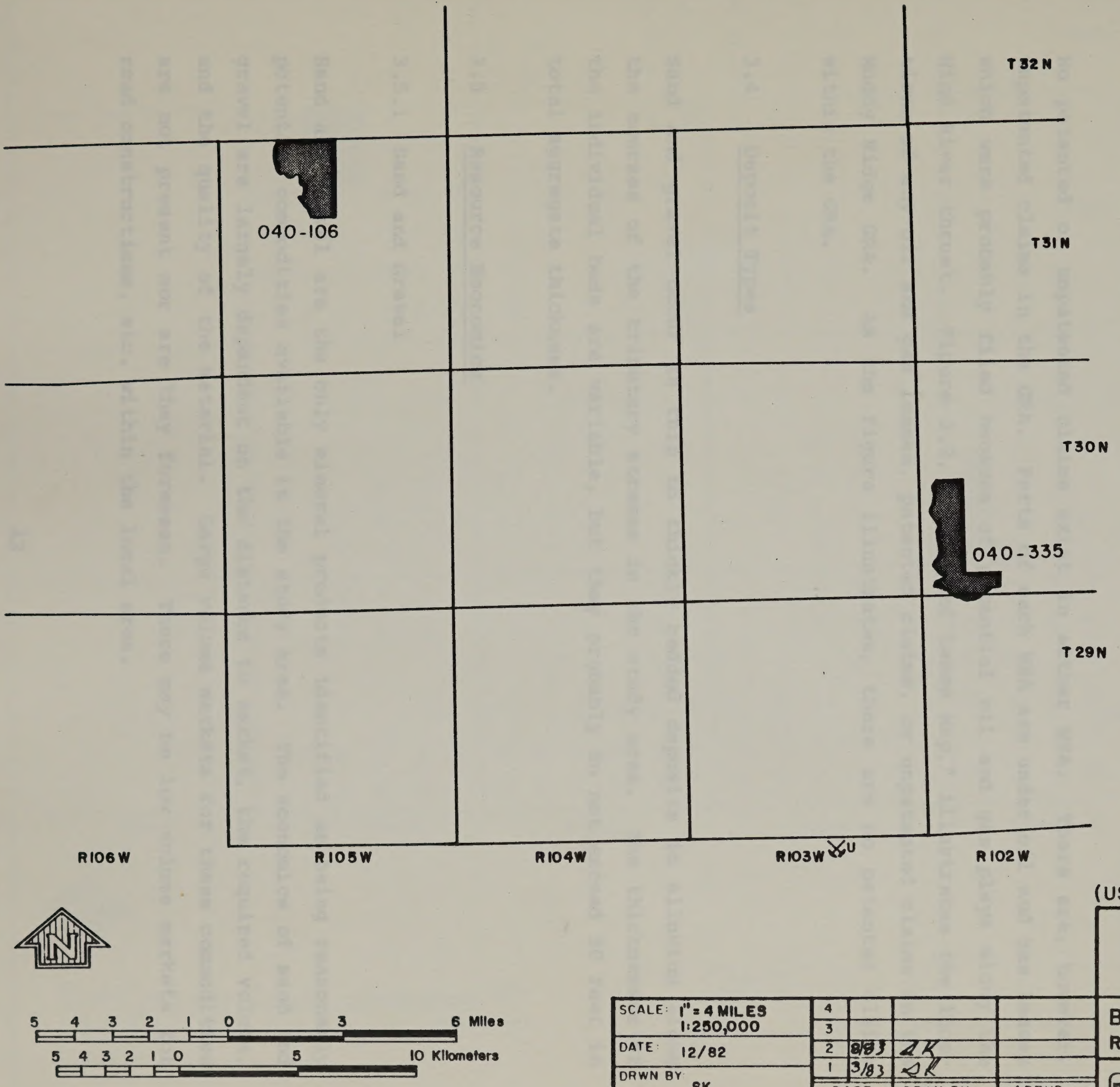
3.1 General

There are no known GEM resource occurrences in either the Mill Creek or East Fork WSAs. The WSAs have the potential for occurrences of gold, sand, and gravel.

Figure 3.1, "Mineral Occurrence Map," illustrates the presence of any known past or present mine locations, and occurrences of mineral deposits and GEM resources within the GRA. The sources of information for this figure are the USGS' Computerized Resource Information Bank (CRIB), and the USBM's Minerals Availability System (MILS).

BLM Wilderness Study Areas Included in the Muddy Ridge GRA

WSA	NAME	ACREAGE
040-106	East Fork	1,415
040-335	Mill Creek	1,300



- ● Oil Well
- ☼ Gas Well
- ✸ Oil & Gas Well
- ⚒ Mine
- ⚒ Inactive Mine
- ■ Ore Body
- ◧ Deposit
- ▨ Approximate Boundary of Wilderness Study Area

COMMODITY

U Uranium

(USGS,1982; USBM,1982)

Muddy Ridge GRA, Wyoming

MINERAL OCCURRENCE MAP

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BLM GEM RESOURCES ASSESSMENT

REGION 6 WYOMING and MONTANA

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FIGURE 3.1

3.2 Potential Resources

Sand and gravel occur as thin deposits in alluvium along the major tributaries within both WSAs, and in glacial deposits throughout the East Fork River WSA. These materials are probably only suitable for local purposes because of their abundance throughout the region. These potential resources were identified by a brief review of the aerial photography of the WSAs.

3.3 Land Status

No patented or unpatented claims exist in either WSA. There are, however, unpatented claims in the GRA. Parts of each WSA are under oil and gas leases which were probably filed because of potential oil and gas plays along the Wind River thrust. Figure 3.2, "Claim and Lease Map," illustrates the locations of any oil and gas leases, patented claims, or unpatented claims in the Muddy Ridge GRA. As the figure illustrates, there are no patented claims within the GRA.

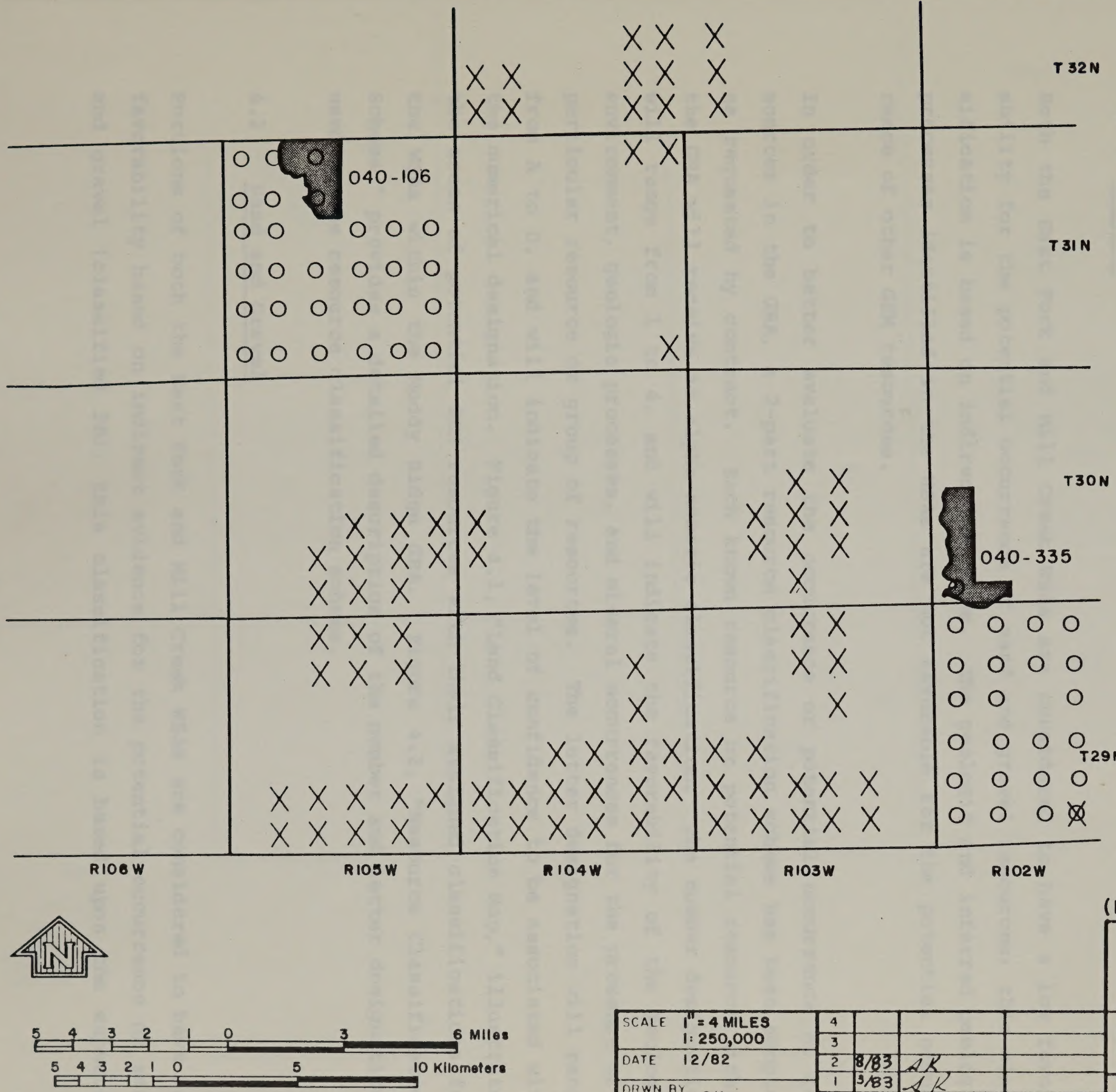
3.4 Deposit Types

Sand and gravel occur as thin to thickly bedded deposits in alluvium along the courses of the tributary streams in the study area. The thicknesses of the individual beds are variable, but they probably do not exceed 50 feet in total aggregate thickness.

3.5 Resource Economics

3.5.1 Sand and Gravel

Sand and gravel are the only mineral products identified as being reasonably potential commodities available in the study area. The economics of sand and gravel are largely dependent on the distance to market, the required volume, and the quality of the material. Large volume markets for these commodities are not present nor are they foreseen. There may be low volume markets for road constructions, etc. within the local area.



BLM Wilderness Study Areas Included in the Muddy Ridge GRA

WSA	NAME	ACREAGE
040-106	East Fork	1,415
040-335	Mill Creek	1,300

○ Oil & Gas Lease

△ Patented Claim

X Unpatented Claim

▨ Approximate Boundary of Wilderness Study Area

NOTE: Symbols illustrate those sections where claims or leases are present

(BLM,1982)

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Muddy Ridge GRA, Wyoming

CLAIM and LEASE MAP

BLM GEM RESOURCES ASSESSMENT
REGION 6 WYOMING and MONTANA

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FIGURE 3.2

3.5.2 Strategic and Critical Minerals

There have been no deposits or occurrences of strategic or critical minerals identified in the study area, and the favorability for the potential occurrence of these minerals should be considered low.

4.0 LAND CLASSIFICATION FOR GEM RESOURCES

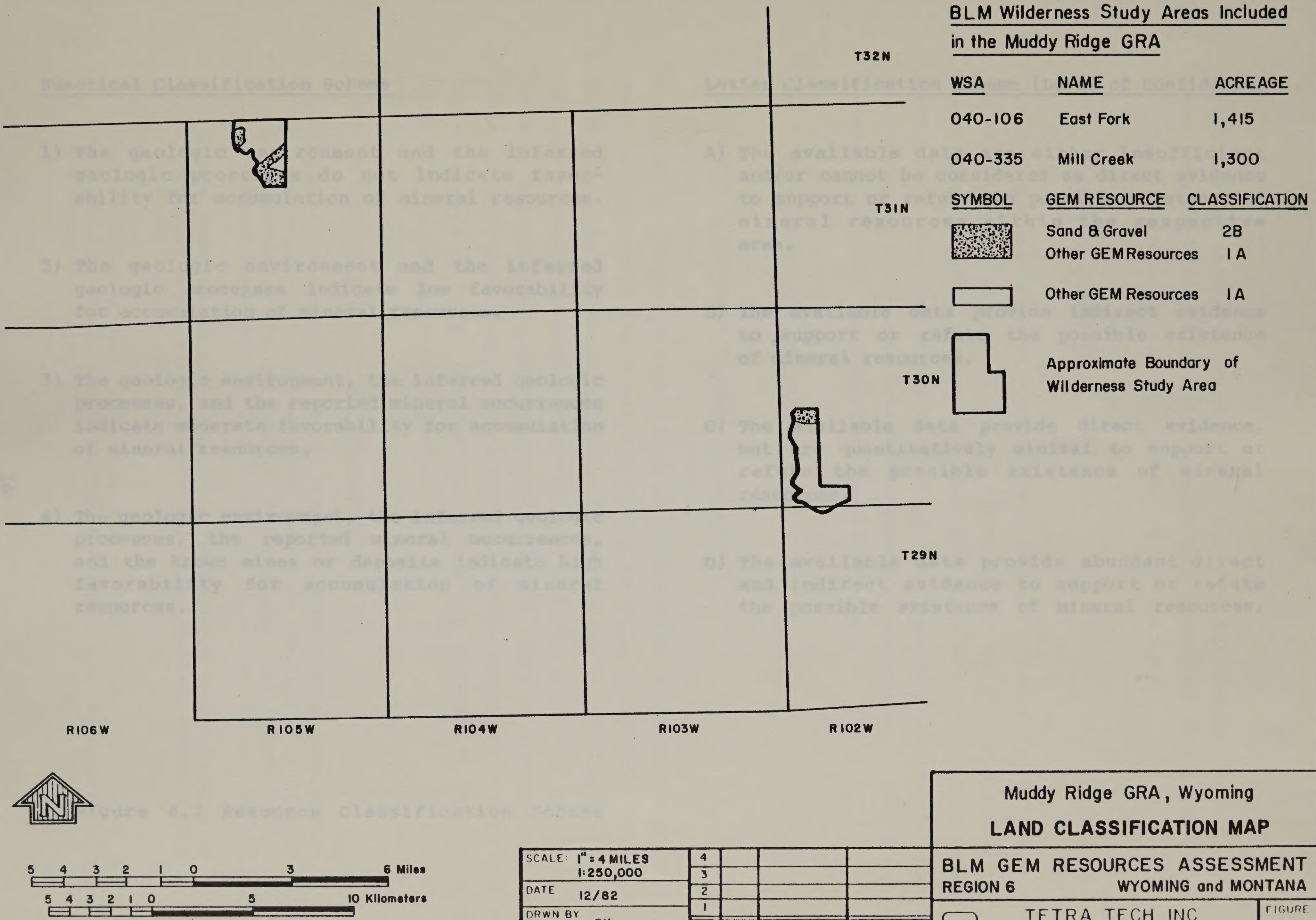
4.1 General

Both the East Fork and Mill Creek WSAs are considered to have a low favorability for the potential occurrence of sand and gravel resources; this classification is based on indirect evidence. The geologic and inferred geologic processes identified in the WSAs are not favorable for the potential occurrence of other GEM resources.

In order to better evaluate the occurrence or potential occurrence of resources in the GRA, a 2-part resource classification scheme has been adopted as requested by contract. Each known resource or potential resource within the GRA will receive an alpha-numeric classification. The number designation will range from 1 to 4, and will indicate the favorability of the geologic environment, geologic processes, and mineral occurrences for the presence of a particular resource or group of resources. The letter designation will range from A to D, and will indicate the level of confidence to be associated with the numerical designation. Figure 4.1, "Land Classification Map," illustrates the areas of potential GEM resources with their assigned classifications for the WSAs within the Muddy Ridge GRA. Figure 4.2, "Resource Classification Scheme," provides a detailed description of the number and letter designations used in the resource classification scheme.

4.2 Sand and Gravel

Portions of both the East Fork and Mill Creek WSAs are considered to have low favorability based on indirect evidence for the potential occurrence of sand and gravel (classified 2B); this classification is based upon the expected



BLM Wilderness Study Areas Included in the Muddy Ridge GRA

WSA	NAME	ACREAGE
040-106	East Fork	1,415
040-335	Mill Creek	1,300

SYMBOL	GEM RESOURCE	CLASSIFICATION
▨	Sand & Gravel Other GEM Resources	2B 1A
▭	Other GEM Resources	1A
▭	Approximate Boundary of Wilderness Study Area	

Muddy Ridge GRA, Wyoming

LAND CLASSIFICATION MAP

BLM GEM RESOURCES ASSESSMENT
REGION 6 WYOMING and MONTANA

TETRA TECH INC.
PASADENA, CALIFORNIA

FIGURE 4.1

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Numerical Classification Scheme

1) The geologic environment and the inferred geologic processes do not indicate favorability for accumulation of mineral resources.

2) The geologic environment and the inferred geologic processes indicate low favorability for accumulation of mineral resources.

3) The geologic environment, the inferred geologic processes, and the reported mineral occurrences indicate moderate favorability for accumulation of mineral resources.

4) The geologic environment, the inferred geologic processes, the reported mineral occurrences, and the known mines or deposits indicate high favorability for accumulation of mineral resources.

Letter Classification Scheme (Level of Confidence)

A) The available data are either insufficient and/or cannot be considered as direct evidence to support or refute the possible existence of mineral resources within the respective area.

B) The available data provide indirect evidence to support or refute the possible existence of mineral resources.

C) The available data provide direct evidence, but are quantitatively minimal to support or refute the possible existence of mineral resources.

D) The available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources.

Figure 4.2 Resource Classification Scheme

occurrence of these resources within alluvium and glacial deposits of the area. The alluvium and glacial deposits were identified by a brief review of the aerial photography and topographic maps of the area.

4.3 Other GEM Resources

The geologic environment and inferred geologic processes that have been identified in the study area are not favorable for the potential occurrence of other GEM resources. Also, the available information is insufficient to support or refute the existence of other GEM resources. Therefore, both the East Fork and Mill Creek WSAs are considered unfavorable for the potential occurrence of other GEM resources (classified 1A).

5.0 RECOMMENDATIONS FOR FURTHER WORK

5.1 Work Recommended to Complete Data Base

A number of investigations could be implemented to generate additional data to supplement the conclusions of this Phase I report for the Muddy Ridge GRA. An aerial photographic interpretation of the study area would help differentiate surficial deposits from bedrock; once this was done, the contacts between the various geologic materials could be plotted on a large scale geologic map. Also, a field check would help evaluate the potential for the occurrence of other GEM resouces within the Precambrian rock units for which data is at present unavailable.

6.0 REFERENCES AND SELECTED BIBLIOGRAPHY

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